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APPLICATION OF PLATELET-RICH FIBRIN MEMBRANE IN INTRAOPERATIVE SURGICAL REPAIR OF NASAL SEPTUM PERFORATION

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The article examines approaches to intraoperative closure of nasal septum perforation during septoplasty, including the use of platelet-rich fibrin membranes, which occur during septoplasty. The authors analyze the primary causes of this complication, which include mechanical damage to the mucous membrane, excessive cartilage removal, and impaired blood supply to the tissues. Comprehensive treatment was provided to 36 patients hospitalized in the Otolaryngology department for planned surgical treatment of various types of nasal septum deviation associated with impaired nasal breathing and who developed iatrogenic perforation of the nasal septum during surgery. In addition to septum perforation repair, some patients were treated with platelet-rich fibrin membranes, which involves centrifuging 10 ml of the patient's venous blood at 2000 rpm for 15 minutes. The importance of postoperative care is emphasized, which includes regular nasal cavity moisturising, avoidance of physical activity, and prevention of infections. A personalized approach to treatment and the use of modern biomaterials improve the outcomes of perforation closure and minimize the risk of recurrence.

Key words: nasal septum perforation, perforation repair, septoplasty, intraoperative closure, PRF membrane.

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ЗАСТОСУВАННЯ МЕМБРАНИ ЗІ ЗБАГАЧЕНОГО ТРОМБОЦИТАМИ ФІБРИНУ ПРИ ІНТРАОПЕРАЦІЙНІЙ ПЛАСТИЦІ ПЕРФОРАЦІЙ НОСОВОЇ ПЕРЕГОРОДКИ

У статті розглядаються варіанти інтраопераційного закриття перфорації носової перегородки під час септопластики, в тому числі з використанням мембран зі збагаченого тромбоцитами фібрину, що виникає під час септопластики. Автори аналізують основні причини виникнення цього ускладнення, серед яких механічне пошкодження слизової оболонки, надмірне видалення хряща та порушення кровопостачання тканин. Проведено комплексне лікування 36 пацієнтів, які були госпіталізовані в оториноларингологічне відділення для планового хірургічного лікування з приводу різних видів викривлення перегородки носа з порушенням носового дихання і у яких під час оперативного втручання виникла ятрогенна перфорація носової перегородки. Окрім пластики перфорації носової перегородки, деяким пацієнтам застосовували мембрану зі збагаченого тромбоцитами фібрину, отриману шляхом центрифугування 10 мл венозної крові пацієнта при 2000 об/хв протягом 15 хвилин. Наголошується на важливості післяопераційного догляду, що включає регулярне зволоження носової порожнини, уникнення фізичних навантажень та профілактику інфекцій. Персоналізований підхід до лікування та використання сучасних біоматеріалів дозволяють покращити результати закриття перфорацій і мінімізувати ризик рецидивів.

Ключові слова: перфорація носової перегородки, пластика перфорації, септопластика, інтраопераційне закриття, PRF-мембрана.

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One of the common reasons for patients to consult an otolaryngologist is impaired nasal breathing, which is often caused by a deviated nasal septum. Anatomical changes in this case frequently lead to the development of vasomotor rhinitis and can be one of the factors contributing to rhonchopathy, chronic inflammation of the paranasal sinuses, and other conditions. Therefore, when a deviated nasal septum is identified and determined to be a causative factor of the disease, its surgical correction – septoplasty – is performed.

The number of surgical procedures to correct deviated nasal septum is constatntly increasing due to the advancements in diagnostic capabilities in medicine and the growing demands on the quality of life. Along with the increase in cases of surgical correction, there is also an increase in complications during the procedure, one of which is intraoperative nasal septum perforation (INSP) [1]. This condition can become a permanent perforation in the future, leading to significant problems with nasal breathing.

Nasal septum perforation (NSP) is prevalent in up to 0.9 % of the general population [2], and its incidence rises to 9 % after surgical interventions such as septoplasty [2, 3]. NSP is often accompanied by complaints such as crust formation, recurrent nosebleeds, a whistling sound during breathing, painful sensations, and discomfort in the nasal area. In the pathogenesis of postoperative nasal septal perforations (PNSP), impaired microcirculation in the nasal septum are observed due to significant surgical traumas. This can lead to necrotic inflammation of the nasal mucosa, chondromalacia, and subsequent resorption of the quadrangular cartilage caused by the inflammatory process [6, 11].

Surgical closure of NSP is a rather complicated surgical intervention with a high rate of unsatisfactory outcomes [2, 3, 5, 7, 8]. Therefore, improving the efficiency of septoplasty and, in case of perforation, achieving effective intraoperative repair of NSP, is an urgent clinical task of rhinosurgery.

There is a wide range of methods for intraoperative closure of NSP. Small perforations are closed by suturing the edges of the perforation hole, while larger defects are more commonly addressed using artificial materials or autoimplants. Taking into account modern scientific and practical achievements, the use of biocompatible fibrin membranes – PRF – can be highly effective in the area of perforated nasal septum.

To enhance the reparative potential of the perforated area of the nasal septum mucosa, the use of the PRF membrane, prepared from the patient's autoplasma, was deemed appropriate as a part of the perforation closure protocol. It is rich in growth factors that stimulate vascular endothelial formation, positively influence the proliferation and differentiation of osteoblasts, osteoclasts, chondroblasts, and chondrocytes, and also has local anti-inflammatory and immunomodulatory effects [4, 9, 10].

This article discusses options for intraoperative closure of a perforated nasal septum using a PRF membrane.

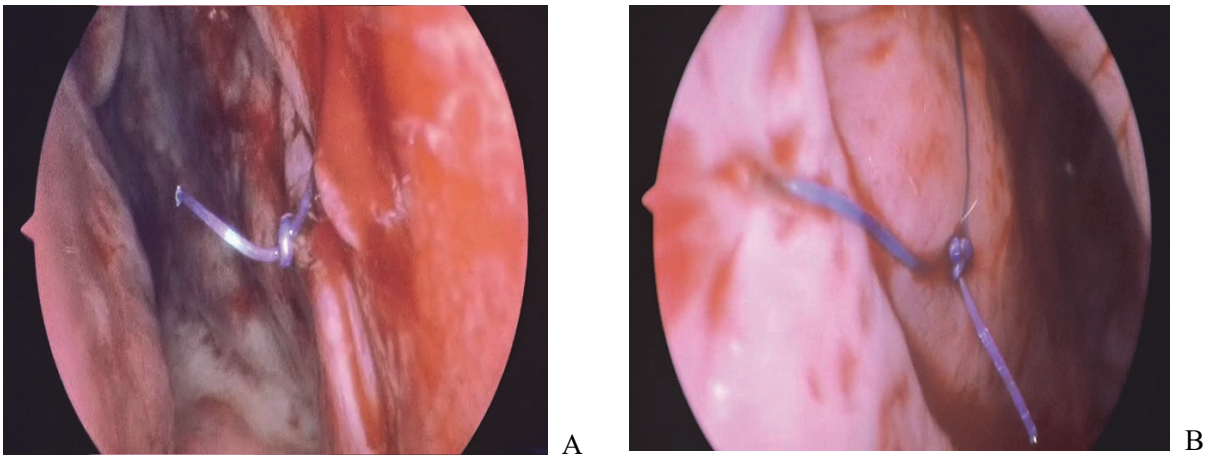
The purpose of the study was to determine the effectiveness of intraoperative surgical repair of nasal septum perforation using platelet-rich fibrin membranes.

Materials and methods. The surgical treatment of patients who were treated in the ENT department of the Poltava Regional Clinical Hospital named after M.V. Sklifosovsky from 2021 to 2024, where they underwent septoplasty, was conducted. During this period, a total of 1517 septoplasties were performed, accounting for 13.52 % of all surgical procedures carried out in the ENT department. In 36 patients hospitalised for deviated nasal septum with nasal breathing disorder, septoplasty resulted in intraoperative perforation of the nasal septum (IPNS) requiring intraoperative plastic surgery. There were 25 (69.4 %) men, and 11 (30.6 %) women; the average age of the patients was 38 years (from 19 to 64 years).

The inclusion criteria for the study were the signs of nasal septum perforation in the anterior and middle parts of the nasal cavity. Patients with inflammatory diseases of the upper respiratory tract, allergic rhinitis, nasal polyps, or concomitant diseases such as diabetes mellitus, cystic fibrosis, or bronchial asthma were excluded. The diagnosis of nasal septum deviation with impaired nasal breathing was based on the presence of typical complaints, endoscopic findings, CT imaging, and, when necessary, rhinomanometry.

Given that intraoperative nasal septum perforation is an unexpected and often unpredictable complication of surgical intervention, the method for closing INSP was determined directly during the surgical procedure. In all cases, the perforation window had a diameter of approximately 5 mm, which, according to the classification of nasal septum perforations, corresponds to a small perforation [7]. Initially, when identifying the presence of a nasal septum perforation, remnants of cartilage or bone tissue were removed, followed by suturing the mucous membrane on both sides using monofilament suture material.

Based on the choice of the method for closing the intraoperative perforation, patients were divided into two groups. Group I included 17 patients who underwent NSP plastic surgery by applying suture ligatures (Fig. 1), followed by the placement of silicone septal splints with an airway for 7 days. Group II consisted of 19 patients who, in addition to NSP repair, received a PRF membrane application.



A B

Fig. 1. Sutured perforation of the nasal septum: A – right side of the nasal cavity, B – left side of the nasal cavity.

The PRF membrane was obtained from an A-PRF clot intraoperatively according to the standard protocol [4]: patients' venous blood was collected in 10 ml glass tubes without a clotting activator and

separation gel. After the blood was collected into the glass tubes, it was centrifuged using a Hettich EBA 200 centrifuge (Germany) at 2000 rpm for 15 minutes. After centrifugation, three layers were formed in the tube: the lower layer consisted of erythrocytes, fibrin and a red clot were in the middle, and the upper layer was serum. The ready-made PRF clot was then extracted from the tube with tweezers, separated from the red clot, and shaped into a membrane, which was placed under a splint acting as a fixator. A ready-made schematic representation of the method of nasal septum perforation closure using a PRF membrane is shown in Fig. 2.

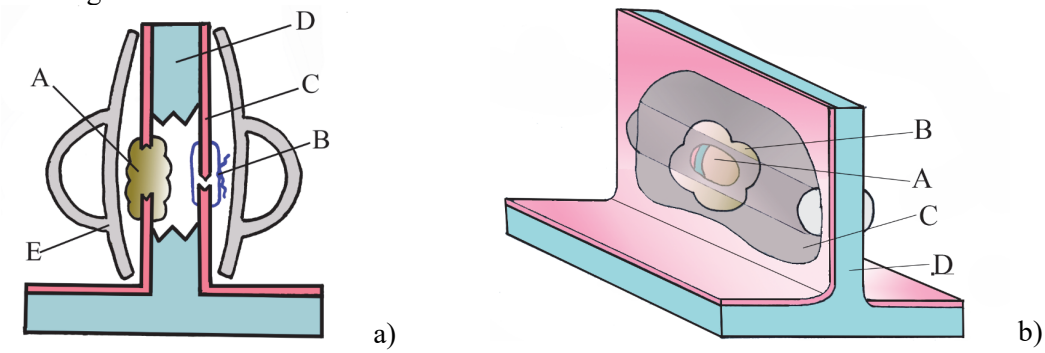


Fig. 2. Schematic representation of NSP repair in two projections. A: a – A-PRF clot, b – suture applied to the edges of the wound, c – mucous membrane of the nasal septum, d – fragment of the quadrangular cartilage, e – silicone splint. B: a – sutured NSP, b – A-PRF clot, c – silicone splint, d – quadrangular cartilage.

The analysis of the results of intraoperative nasal septum perforation closure was performed on days 7 and 14 post-surgery. It was based on endoscopic examination of the nasal septum mucosa condition and the Visual Analog Scale (VAS) [5] according to the following subjective criteria: nasal breathing condition, nasal discharge, and crust formation. Statistical analysis was performed using the Mann-Whitney U-test to determine significant differences in the compared parameters in the study groups.

Results of the study and their discussion. Characteristics of the Patients in Group I. During endoscopy of the nasal cavity after the removal of nasal splints among Group I patients (on the 7th day after surgery), signs of nasal septum perforation were observed in 1 patient (5.9 %). Formation of abundant fibrin films was noted in 12 patients (70.6 %), hemorrhagic crusts in 9 patients (52.9 %), and atrophic changes of the mucous membrane were detected in 5 patients (29.4 %).

On the 14th day after surgery, perforation was detected in 2 more patients, thus, in this group, recurrence of nasal septum perforation (NSP) was noted in a total of 3 patients (17.6 %). The perforation sizes varied from 3 to 5 mm and remained stable. The recurrence of perforation was preceded by the formation of hemorrhagic crusts, which were removed after their preliminary treatment with isotonic saline solution or hydrogel-based solutions. In other cases, the healing of the nasal septum mucosa proceeded normally. Atrophic changes in the mucosa were recorded in 5 patients (29.4 %). Hemorrhagic crusts and fibrin films were noted in 1 case (5.9 %), resulting from an external factor (nasal trauma). Nasal cavity synechiae developed in 4 patients (23.5 %), which was explained by the inadequate management of the patient's postoperative period.

According to data obtained during the monitoring of patients in the postoperative period using the Visual Analog Scale, patients in Group I (n=17, M±σ) on the 7th postoperative day reported the following scores: the index of nasal breathing condition was 3.82±2.04, of nasal discharge – 4.29±1.93, and of crust formation it was 4.12±2.2. When conductuing a survey ob the 14th day, the index was as follows: nasal breathing condition – 3.18±1.78, nasal discharge – 3.12±1.17, and crust formation – 3.35±2.23.

Characteristics of the Patients in Group II.

In all patients of Group II, no signs of postoperative nasal perforation were observed in the early postoperative period – on the 7th day of observation. Abundant fibrinous films in the nasal passages were detected in 14 patients (73.7 %), hemorrhagic crusts in 6 patients (31.6 %), and atrophic changes in the mucous membrane in 3 patients (15.8 %).

At the control examination on the 14th day of postoperative period, signs of PNP recurrence were found in 1 patient (5.3 %). No hemorrhagic crusts or fibrinous films were detected, and the epithelialization of the mucous membrane was overall better than in the patients of Group I. Synechiae of the nasal cavity occurred in 3 cases (15.8 %), caused by non-compliance with postoperative recommendations.

According to the data obtained during the monitoring of the postoperative period by parients using the VAS, in Group II (n=19, M±σ) on the 7th day of the postoperative period, the index of the nasal breathing condition was 3.42±1.63; of the nasal discharge it was 2.95±1.35 (had statistically significant differences ($p \leq 0.05$) compared to Group I patients); of crust formation 2.84±1.3 (had statistically

significant differences ($p \leq 0.05$) compared to Group I patients). During the survey on the 14th day, the index of the nasal breathing condition was 2.47±1.31; of the nasal discharge 2.79±1.40; and crust formation 2.68±1.29.

Thus, according to the data obtained during the monitoring of patients in the postoperative period using the VAS, statistically significant differences were observed in Group II patients on the 7th day postoperatively in terms of nasal discharge and crust formation (Table 1). On the 14th day, this indicator did not have statistically significant differences.

Table 1

Assessment according to the VAS scale, M±σ, * – p<0.05 between the indices of Group I and Group II on day 7

	Day 7		Day 14	
Evaluation Parameter	Group I (N=17)	Group II (N=19)	Group I (N=17)	Group II (N=19)
Nasal Breathing Condition	3.82±2.04	3.42±1.63	3.18±1.78	2.47±1.31
Nasal Discharge	4.29±1.93	2.95±1.35*	3.12±1.17	2.79±1.40
Crust Formation	4.12±2.2	2.84±1.3*	3.35±2.23	2.68±1.29

Patients who had a recurrence with the formation of persistent nasal perforation (3 patients from Group I and 1 patient from Group II) underwent intraoperative nasal septum perforation one year after the surgery. The procedure involved suturing the edges of the perforation without excessive tension, after preliminary refreshing of the edges and inserting a strip of PRF membrane with dyed autocartilage between the layers.

During the preparation stage for surgical intervention, it is necessary to predict conditions that may lead to complications during septoplasty. These include traumatic deviations of the nasal septum with scars and synechiae in the nasal cavity, as well as atrophic processes of the nasal mucosa, including those caused by systematic use of decongestants. A thorough study of the architectonics of the nasal septum allows to identify “problem areas” with thinning of the mucosal layer, cartilage, or bony structures. In such cases, it is advisable to prepare in advance for a potentially complicated course of septoplasty, plan the strategy for working in problematic zones, and perform the necessary preoperative preparation of the patient, primarily aimed at eliminating signs of mucosal atrophy [1].

In the event of a nasal septal perforation, it is advisable to pause and determine the size of the perforation. For this purpose, it is best to use a 30° endoscope and an instrument with a ruler included in the endoscopic kit. After assessing the perforation area, an action algorithm involving the use of a PRF membrane can be applied.

When suturing NSP, monofilament suture material with a thickness of 5/0 and a 1/2 circle cutting needle were chosen. An important task is to carefully suture and completely eliminate the mucous membrane defect from at least one side of the nose. It should be noted that these actions are technically challenging due to the relatively narrow nasal passages and require highly professional surgical skills. When closing the defect, it is essential to avoid excessive tension on the flaps, as this may lead to flap necrosis or recurrence of the perforation. It is important to remember that even a small unclosed NSP can entirely negate the results of the surgery, so considerable attention should be paid to this aspect, which can be the key to successful septoplasty.

According to our observations, there is no need to use cartilage autografts for small NSP, provided that the mucous membrane of the nasal septum is completely matched on at least one side of the perforation.

During daily nasal cavity care, it is recommended to minimize the use of decongestants in the nasal cavity, limit the application of topical corticosteroids, and avoid overly aggressive removal of crusts.

All patients were thoroughly instructed after discharge. They were advised to avoid forced nasal breathing, intensive exhalation to clear mucus from the nose, and avoid staying in places with overly dry air.

When using PRF membranes, any systemic or local allergic or inflammatory reactions were not observed, which confirms that the applied autotissue is fully biocompatible with the body. The method of obtaining PRF membranes is quick, cost-efficient to use, and safe, making its implementation in clinical practice both secure and effective.

It is essential to remember that one of the primary ways to prevent perforation is to handle the nasal septum mucosa carefully during surgery. Excessive removal of cartilage and simultaneous damage to the mucosa on both sides of the septum should be avoided. Preserving the perichondrium and periosteum is critically important for maintaining blood supply to the tissue. The use of atraumatic instruments and techniques that minimize damage significantly reduces the likelihood of perforation.

After closing the perforation, appropriate postoperative care must be provided. Patients are advised to regularly moisturize the nasal passages with saline solutions, which may contain sodium hyaluronate,

and oil drops to prevent dryness of the mucous membrane. Blowing the nose should also be avoided during the first few weeks after surgery to prevent displacement of mucosal flaps or silicone splints.

Thus, the use of the PRF membrane during surgical intraoperative surgical repair of nasal septum perforation can be applied to reduce the likelihood of persistent NSP formation and improve the quality of life in the postoperative period.

Conclusions

1. Perforation of the nasal septum, occurring during septoplasty, is a complex complication that requires immediate intraoperative closure to ensure best optimal results and avoid long-term negative consequences for the patient.

2. The success of treatment largely depends on a number of factors, including the surgeon's professional skill, the correct choice of the defect closure technique, and adequate postoperative care. Surgical intervention should be accompanied by a delicate technique to avoid additional tissue trauma and to provide optimal conditions for healing.

3. Postoperative care is critically important to prevent complications. Regular hydration of the nasal mucosa, restriction of physical exertion, avoidance of nose blowing, and infection prevention help accelerate the healing process and reduce the risk of perforation recurrence.

4. For small perforations, the optimal approach is suturing the edges of the mucous membranes with the obligatory preservation of their blood supply and fixation using silicone splints.

5. The use of the proposed method of intraoperative closure of the perforation hole using a PRF membrane reduces the likelihood of persistent perforation formation and contributes to more dynamic restoration of nasal respiratory function. Additionally, it significantly decreases the formation of postoperative crusting and nasal discharge.

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